

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

APPLICANT: Kitson et al.

SERIAL No. Unassigned

EXAMINER: Unassigned

FILED: Herewith

GROUP NO.: Unassigned

TITLE: LIQUID CRYSTAL ALIGNMENT

ATTORNEY DOCKET NO. 30001065

Assistant Commissioner For Patents

Washington, D.C. 20231

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DAVID L. BARNES  
Name  
[Signature]  
Signature

**PRELIMINARY AMENDMENT**

Dear Sir:

Please amend the application as follows:

**IN THE CLAIMS**

All of the claims, whether amended or not, are shown below for the convenience of the Examiner.

1. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;  
  
electrodes for applying an electric field across at least some of the liquid crystal material; and a surface alignment structure on the inner surface of at least the first cell wall providing a single desired alignment to the liquid crystal director, wherein the said surface alignment structure comprises a two dimensional array of upstanding features which are at least one of shaped and orientated to produce the desired alignment; but not including any device in which the surface alignment structure comprises a sinusoidal bigrating.
2. (Amended) A device as claimed in claim 1, wherein the features have a height

in the range of about 0.5 to 5  $\mu\text{m}$ .

3. (Amended) A device as claimed in claim 1, wherein the features have a height in the range of about 1.0 to 1.2  $\mu\text{m}$ .
4. A device as claimed in claim 1, wherein at least part of a side wall of the features is tilted with respect to the normal to the plane of the first cell wall.
5. (Amended) A device as claimed in claim 1, wherein each feature has a width in the range of about 0.2 to 3  $\mu\text{m}$ .
6. (Amended) A device as claimed in claim 1, wherein the features are spaced from about 0.1 to 5  $\mu\text{m}$  apart from each other.
7. A device as claimed in claim 1, wherein the liquid crystal material contains a surfactant.
8. (Amended) A device as claimed in claim 1, wherein the features are formed from at least one of a photoresist or a plastics material.
9. (Amended) A device as claimed in claim 1, wherein the features are of at least one of a different height, different shape, different tilt and different orientation in different regions of the device.
10. (Amended) A device as claimed in claim 1, wherein the upstanding features are formed from at least one of a photoresist material or a plastics material.
11. (Amended) A cell wall for use in manufacturing a liquid crystal device according to claim 1, comprising a wall and an alignment structure on one surface thereof for providing a single desired alignment to the director of a liquid crystal material, said alignment structure comprising a two dimensional array of upstanding features which are at least one of shaped and orientated to produce the desired alignment; said cell wall excluding any cell wall in which the surface alignment structure comprises a sinusoidal bigrating.
12. (Amended) A method of manufacturing a cell wall in accordance with claim 11,

comprising applying a photoresist material to a surface of a wall, exposing the applied photoresist material to a suitable light source through a suitably patterned mask, removing soluble photoresist, and hardening the exposed photoresist material to produce a two dimensional array of alignment features on the wall; said method excluding any method which produces a sinusoidal bigrating.

13. (Amended) A method of manufacturing a cell wall in accordance with claim 10, comprising applying a plastics material to the surface of a wall, and embossing a two dimensional array of alignment features into the plastics material; said method excluding any method which produces a sinusoidal bigrating.

14. A method of manufacturing a liquid crystal device in accordance with claim 1, comprising securing a first cell wall in accordance with claim 13 to a second cell wall, so as to produce a cell having spaced apart cell walls; filling the cell with a liquid crystal material, and sealing the cell; wherein one or both of the cell walls have at least one electrode structure thereon so that the device has electrode structures for applying an electric field across at least some of the liquid crystal material.

15. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material; and a surface alignment structure on the inner surface of at least the first cell wall providing at least one of a desired homeotropic or tilted homeotropic alignment to the liquid crystal director, wherein the said surface alignment structure comprises an array of upstanding features which are at least one of shaped and orientated to produce the desired alignment.

16. A device as claimed in claim 15, wherein the height of the features is at least equal to the average spacing between the features.

17. (Amended) A device as claimed in claim 15, wherein at least part of a side wall of the features is tilted with respect to the normal to the plane of the first cell wall.

18. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material;

and a surface alignment structure on the inner surface of at least the first cell wall providing a desired alignment to the liquid crystal director in a single azimuthal direction, wherein the said surface alignment structure comprises an array of upstanding posts which are at least one of shaped and orientated to produce the desired alignment.

19. A device as claimed in claim 18, wherein the posts are tilted with respect to the normal of the plane of the first cell wall.

20. (Amended) A device as claimed in claim 18, wherein each post comprises a discrete structure.

21. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material;

and a surface alignment structure on the inner surface of at least the first cell wall providing desired alignments to the liquid crystal director in a plurality of azimuthal directions, wherein the said surface alignment structure comprises an array of features which are at least one of shaped and orientated to produce the desired alignments, wherein the distortion energy of the liquid crystal material is not the same in all of the said azimuthal directions.

22. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material;

and a surface alignment structure on the inner surface of at least the first cell wall providing desired alignments to the liquid crystal director in at least three azimuthal directions, wherein the said surface alignment structure comprises an array of features which are at least one of shaped and orientated to produce the desired alignments.

**Remarks**

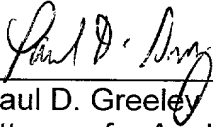
Claims 1-3, 5, 6, 8-13, 15, 17, 18, and 20-22 have been amended to eliminate any indefiniteness.

Claim 17 has been amended to correct a typographical error with regard to its dependency.

Attached hereto is a marked up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version With Markings to Show Changes Made."

3-23-01  
Date

Respectfully submitted,

  
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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS

All of the claims, whether amended or not, are shown below for the convenience of the Examiner.

1. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;  
  
electrodes for applying an electric field across at least some of the liquid crystal material; and a surface alignment structure on the inner surface of at least the first cell wall providing a single desired alignment to the liquid crystal director, wherein the said surface alignment structure comprises a two dimensional array of upstanding features which are at least one of shaped and [/or] orientated to produce the desired alignment; but not including any device in which the surface alignment structure comprises a sinusoidal bigrating.
2. (Amended) A device as claimed in claim 1, wherein the features have a height in the range of about 0.5 to 5  $\mu\text{m}$ .
3. (Amended) A device as claimed in claim 1, wherein the features have a height in the range of about 1.0 to 1.2  $\mu\text{m}$ .
4. A device as claimed in claim 1, wherein at least part of a side wall of the features is tilted with respect to the normal to the plane of the first cell wall.
5. (Amended) A device as claimed in claim 1, wherein each feature has a width in the range of about 0.2 to 3  $\mu\text{m}$ .
6. (Amended) A device as claimed in claim 1, wherein the features are spaced from about 0.1 to 5  $\mu\text{m}$  apart from each other.
7. A device as claimed in claim 1, wherein the liquid crystal material contains a surfactant.

8. (Amended) A device as claimed in claim 1, wherein the features are formed from at least one of a photoresist or a plastics material.
9. (Amended) A device as claimed in claim 1, wherein the features are of at least one of a different height, different shape, different tilt and [/or] different orientation in different regions of the device.
10. (Amended) A device as claimed in claim 1, wherein the upstanding features are formed from at least one of a photoresist material or a plastics material.
11. (Amended) A cell wall for use in manufacturing a liquid crystal device according to claim 1, comprising a wall and an alignment structure on one surface thereof for providing a single desired alignment to the director of a liquid crystal material, [the] said alignment structure comprising a two dimensional array of upstanding features which are at least one of shaped and [/or] orientated to produce the desired alignment; [but not including] said cell wall excluding any cell wall in which the surface alignment structure comprises a sinusoidal bigrating.
12. (Amended) A method of manufacturing a cell wall in accordance with claim 11, comprising applying a photoresist material to a surface of a wall, exposing the applied photoresist material to a suitable light source through a suitably patterned mask, removing soluble photoresist, and hardening the exposed photoresist material to produce a two dimensional array of alignment features on the wall; [but not including] said method excluding any method which produces a sinusoidal bigrating.
13. (Amended) A method of manufacturing a cell wall in accordance with claim 10, comprising applying a plastics material to the surface of a wall, and embossing a two dimensional array of alignment features into the plastics material; [but not including] said method excluding any method which produces a sinusoidal bigrating.
14. A method of manufacturing a liquid crystal device in accordance with claim 1, comprising securing a first cell wall in accordance with claim 13 to a second cell wall, so as to produce a cell having spaced apart cell walls; filling the cell with a liquid crystal material, and sealing the cell; wherein one or both of the cell walls have at least one

electrode structure thereon so that the device has electrode structures for applying an electric field across at least some of the liquid crystal material.

15. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material; and a surface alignment structure on the inner surface of at least the first cell wall providing at least one of a desired homeotropic or tilted homeotropic alignment to the liquid crystal director, wherein the said surface alignment structure comprises an array of upstanding features which are at least one of shaped and [/or] orientated to produce the desired alignment.

16. A device as claimed in claim 15, wherein the height of the features is at least equal to the average spacing between the features.

17. (Amended) A device as claimed in claim [1] 15, wherein at least part of a side wall of the features is tilted with respect to the normal to the plane of the first cell wall.

18. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material;

and a surface alignment structure on the inner surface of at least the first cell wall providing a desired alignment to the liquid crystal director in a single azimuthal direction, wherein the said surface alignment structure comprises an array of upstanding posts which are at least one of shaped and [/or] orientated to produce the desired alignment.

19. A device as claimed in claim 18, wherein the posts are tilted with respect to the normal of the plane of the first cell wall.

20. (Amended) A device as claimed in claim 18, wherein each post [is] comprises a discrete structure.



21. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material;

and a surface alignment structure on the inner surface of at least the first cell wall providing desired alignments to the liquid crystal director in a plurality of azimuthal directions, wherein the said surface alignment structure comprises an array of features which are at least one of shaped and [/or] orientated to produce the desired alignments, wherein the distortion energy of the liquid crystal material is not the same in all of the said azimuthal directions.

22. (Amended) A liquid crystal device comprising a first cell wall and a second cell wall enclosing a layer of liquid crystal material;

electrodes for applying an electric field across at least some of the liquid crystal material;

and a surface alignment structure on the inner surface of at least the first cell wall providing desired alignments to the liquid crystal director in at least three azimuthal directions, wherein the said surface alignment structure comprises an array of features which are at least one of shaped and [/or] orientated to produce the desired alignments.